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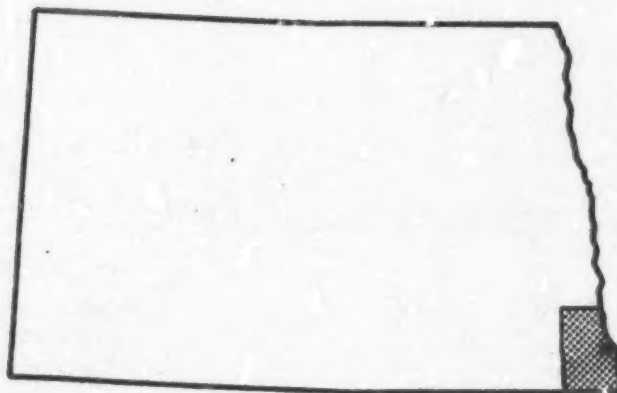
FLOOD INSURANCE STUDY



24
COMPLETED

ORIGINAL

CITY OF
WAHPETON,
NORTH DAKOTA
RICHLAND COUNTY



Federal Emergency Management Agency

COMMUNITY NUMBER - 380100

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
CITY OF WAHPETON, RICHLAND COUNTY, NORTH DAKOTA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the incorporated areas of the City of Wahpeton, Richland County, North Dakota, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), St. Paul District, the study contractor for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-EMW-E-1506, Project Order No. 1, Amendment 5. This study was completed in January 1986.

1.3 Coordination

Streams requiring detailed study were initially identified by a FEMA representative during a telephone discussion with the study contractor.

At a subsequent meeting held July 28, 1983 in the City of Wahpeton, the study limits and method of study were discussed and agreed upon. Attending the meeting were representatives of the city, the North Dakota State Water Commission (NDSWC), and the study contractor.

A floodway coordination meeting was held in the city offices on June 20, 1985. Attending the meeting were representatives of the

city, Richland County, the NDSWC, and the study contractor. Potential floodway alignments were discussed and possible floodway alignment problem areas investigated.

On July 14, 1986, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the community, FEMA, and the study contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Wahpeton, North Dakota, including all areas currently subject to its extraterritorial jurisdiction. The area of study is shown on the Vicinity Map (Figure 1).

Riverine flooding on the Red River of the North/Bois de Sioux River was studied in detail from Wahpeton's downstream extraterritorial limit (at section line 21-28) to the upstream extraterritorial limit (at section line 20-29) for a total channel length of 9 miles. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through January 1991.

The scope and methods of study were proposed to, and agreed upon by, FEMA and representatives of the City of Wahpeton.

2.2 Community Description

Wahpeton, meaning the city of leaves, is located in east central Richland County and in the southeast portion of North Dakota. The city is located approximately 210 miles east of Bismarck, North Dakota; approximately 45 miles south of Fargo, North Dakota; and approximately 200 miles northwest of Minneapolis, Minnesota. The total land area within the city is approximately 2.2 square miles. The 1980 city population was 9,065 (Reference 1). The economy of the city depends primarily on agriculture and related enterprise.

The Bois de Sioux, which forms the Minnesota-North Dakota border, flows an extremely winding northerly course between the City of Wahpeton, and Breckenridge, Minnesota. The Ottertail River, which originates in Minnesota, joins the Bois de Sioux near the center of Wahpeton's eastern border. Downstream of the confluence, the Bois de Sioux changes its name and now becomes known as the Red River of the North.

Communities contiguous to Wahpeton include: Center Township, North Dakota to the south and west, Richland County, North Dakota to the north and the City of Breckenridge, Minnesota and Wilkin County, Minnesota, to the east.

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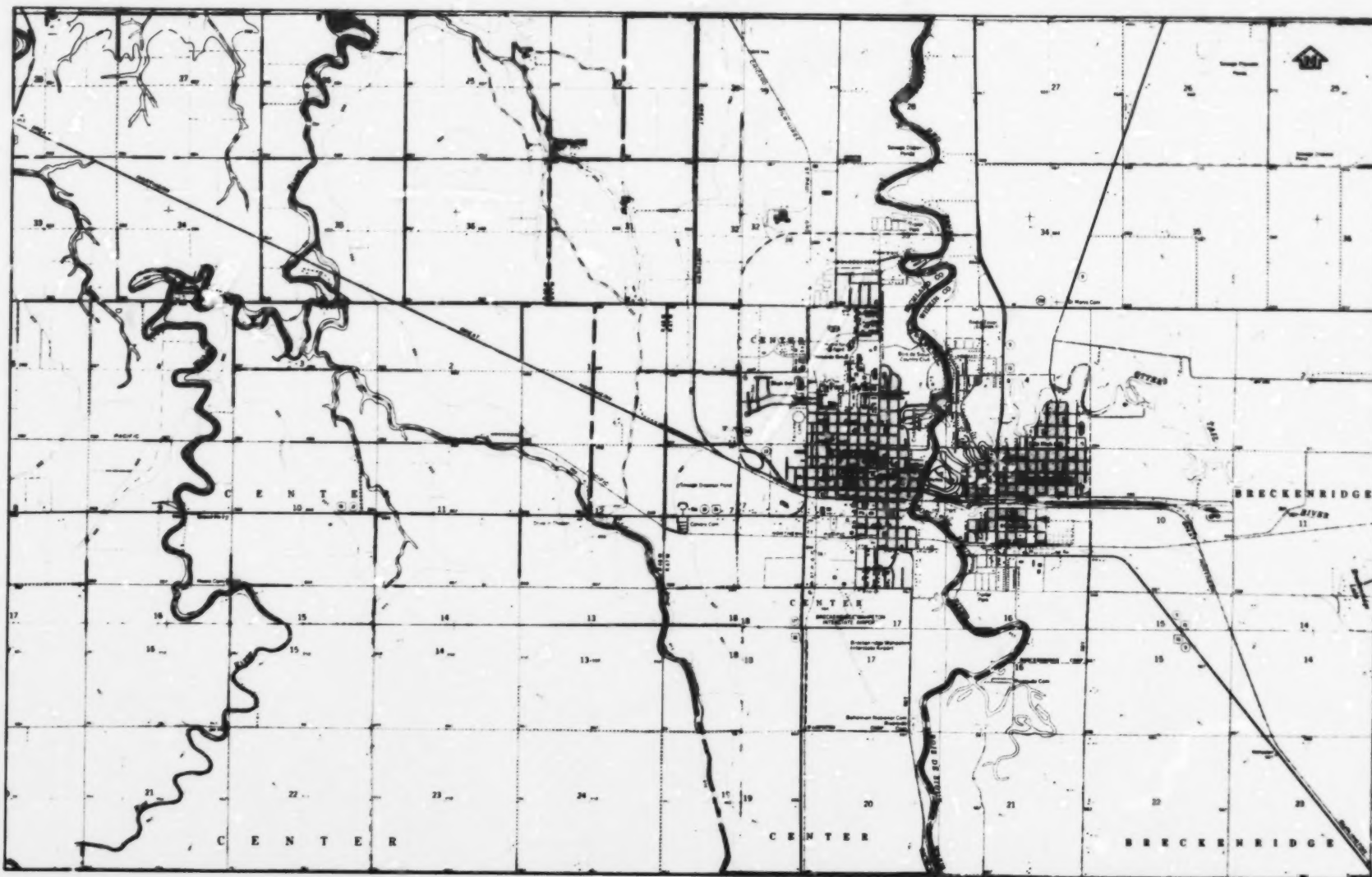


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WAHPETON, ND
(RICHLAND CO.)

APPROXIMATE SCALE



VICINITY MAP

3

Primary land uses in the Bois de Sioux/Red River of the North floodplain areas in the Wahpeton study area are residential development and agricultural uses.

The City of Wahpeton resides in the lake bed of the old Lake Agassiz. The topography, typical to that of lakebeds, is extremely flat - ideal for farming. However, the area's flat relief produces a flooding problem along virtually the entire length of the Red River of the North/Bois de Sioux River within the Wahpeton corporate limits.

The climate of Wahpeton is typical of the Great Plains characterized by cold winters and warm summers. Monthly average temperatures range from a low of 9.6 degrees F. in January to a high of 73.1 degrees F. in July. The mean annual temperature is 43.3 degrees F. Wahpeton averages 20.38 inches of rainfall annually (Reference 2). The majority of the precipitation occurs between April and August. The Wahpeton area has an annual growing season of 130 days.

2.3 Principal Flood Problems

The most severe flooding in Wahpeton occurs as a result of spring snowmelt and/or rainfall. Major floods in recent years occurred in May 1979, April 1969, April 1968, April 1950, and April 1947. The flood of record in Wahpeton occurred in 1897. Table 1 presents the historical flood data for the U.S. Geological Survey (USGS) gage No. 05051500 at Wahpeton (Reference 3.)

TABLE 1. HISTORIC FLOOD DATA
RED RIVER OF THE NORTH, WAHPETON, NORTH DAKOTA

<u>Date</u>	<u>Flow (cfs)¹</u>	<u>Estimated Recurrence Interval</u>
1897	10,500	83
1969	9,200	50
1952	7,130	21
1979	7,050	20
1978	6,250	14
1951	6,090	11
1965	5,690	10
1962	5,650	10

¹ Cubic feet per second.

Flooding associated with ice jams usually occurs only with the smaller floods. During larger floods, a significant portion of the flow is in the overbank areas. In many cases, the ice jams break up before the peak flow occurs. Therefore, they are considered to have a negligible effect on major flooding events.

2.4 Flood Protection Measures

There are no certified, permanent flood control projects in existence in the City of Wahpeton.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1 and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharges for the Red River of the North at Wahpeton, USGS gage No. 05051500, are available since 1942 and were administratively agreed upon in 1971 by the North Dakota State Water Commission, the Minnesota Department of Natural Resources, the U.S. Geological Survey and the Army Corps of Engineers (Reference 4). An analysis of gage data performed in 1982 by the Corps of Engineers (Reference 5) using WRC Bulletin 17B (Reference 6) produced results within the confidence limits of the 1971 curve; thus the 1971 discharge-frequency curve was adopted for this study.

Discharges for the Bois de Sioux River upstream of Wahpeton were developed by the USGS in 1970 for the Breckenridge, Minnesota, Flood Insurance Study (Reference 7). These flows were determined by analyzing the contributing flows from both the Bois de Sioux River and the Otter Tail River using a HEC-2 (Reference 8) approximation of the 1969 flood at Wahpeton.

Peak discharge-drainage area relationships for the Red River of the North at Wahpeton and the Bois de Sioux River upstream of Wahpeton are shown in Table 2.

TABLE 2. SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage area (square miles)	Peak Discharges (cubic feet per second)			
		10-Year	50-Year	100-Year	500-Year
Red River of the North at Wahpeton	4,010	5,700	9,250	11,000	17,150
Bois de Sioux River at Wahpeton	1,967	3,670	5,300	6,200	9,760

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Overbank cross section data and below-water sections (soundings) for the backwater analyses of the Red River of the North/Bois de Sioux River were obtained by field measurement (Reference 9). All bridges, dams, and culverts were field-surveyed to obtain elevation and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the COE HEC-2 step-backwater computer program (Reference 8). The computer model was calibrated using the historical flood profiles of the Bois de Sioux/Red River of the North River.

Roughness factors (Manning's "n") used in the hydraulic computation were chosen by engineering judgment and are based on field observation of the streams and floodplain areas. The roughness values selected for the main channel of the Bois de Sioux/Red River of the North River ranged from 0.045 to 0.060, whereas the floodplain roughness values ranged from 0.050 to 0.090.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for hydraulic models of both reaches were calculated using the slope-area method approximately 5 miles downstream of the study limits.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum (NGVD) of 1929. Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were photogrammetrically interpolated (Reference 10).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Approximate 100-year floodplain boundaries were taken directly from the Flood Hazard Boundary Map (Reference 11).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. In North Dakota, however, floodplain encroachment on the boundary water between North Dakota and Minnesota is limited to a 0.75 foot increase in floodheights above pre-floodway conditions at any point (Reference 12) with 0.25 foot increase attributed to Minnesota and 0.50 foot increase attributed to North Dakota. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study reflect a community selected alignment. The floodway alignment has been coordinated with the NDSWC and the Minnesota Department of Natural Resources because the floodway extends beyond the corporate limits of Wahpeton along the entire length of the detailed study area of the Red River of the North/Bois de Sioux River. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 3). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 0.75 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE ¹	WIDTH ² (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE ³
Red River of the North/Bois de Sioux River								
A	0	309/150	4337	2.5	957.06	957.06	957.81	0.75
B	3,700	342/120	4672	2.4	957.69	957.69	958.44	0.75
C	8,860	1267/75	9745	1.1	958.42	958.42	959.15	0.73
D	12,000	400/240	3961	2.8	958.89	958.89	959.59	0.70
E	12,310	410/270	3944	2.8	958.99	958.99	959.70	0.71
F	14,080	1300/85	9726	1.1	959.38	959.38	960.07	0.69
G	19,430	1200/175	10165	1.1	959.84	959.84	960.51	0.67
H	21,970	500/330	5024	2.2	960.12	960.12	960.81	0.69
I	24,430	800/100	8244	1.3	960.43	960.43	961.14	0.71
J	25,800	1630/80	13916	0.8	960.55	960.55	961.25	0.70
K	26,500	400/100	4178	1.5	960.66	960.66	961.34	0.68
L	27,140	393/100	5210	1.2	961.11	961.11	961.76	0.65
M	28,315	500/400	5677	1.1	961.16	961.16	961.81	0.65
N	31,280	630/350	4465	1.4	961.33	961.33	961.99	0.66
O	35,530	2211/2040	13787	0.4	961.54	961.54	962.21	0.67
P	40,780	550/150	4753	1.3	961.75	961.75	962.38	0.63
Q	43,240	407/130	4015	1.5	961.95	961.95	962.55	0.60
R	45,960	400/120	4133	1.5	962.20	962.20	962.76	0.56

¹ Feet above downstream extraterritorial limit.² Width/width within corporate limits.³ 0.50 foot increase allowable by North Dakota and 0.25 foot increase allowable by Minnesota for a 0.75 foot maximum increase total.

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WAHPETON, ND
(RICHLAND CO.)

FLOODWAY DATA

RED RIVER OF THE NORTH/BOIS DE SIOUX RIVER

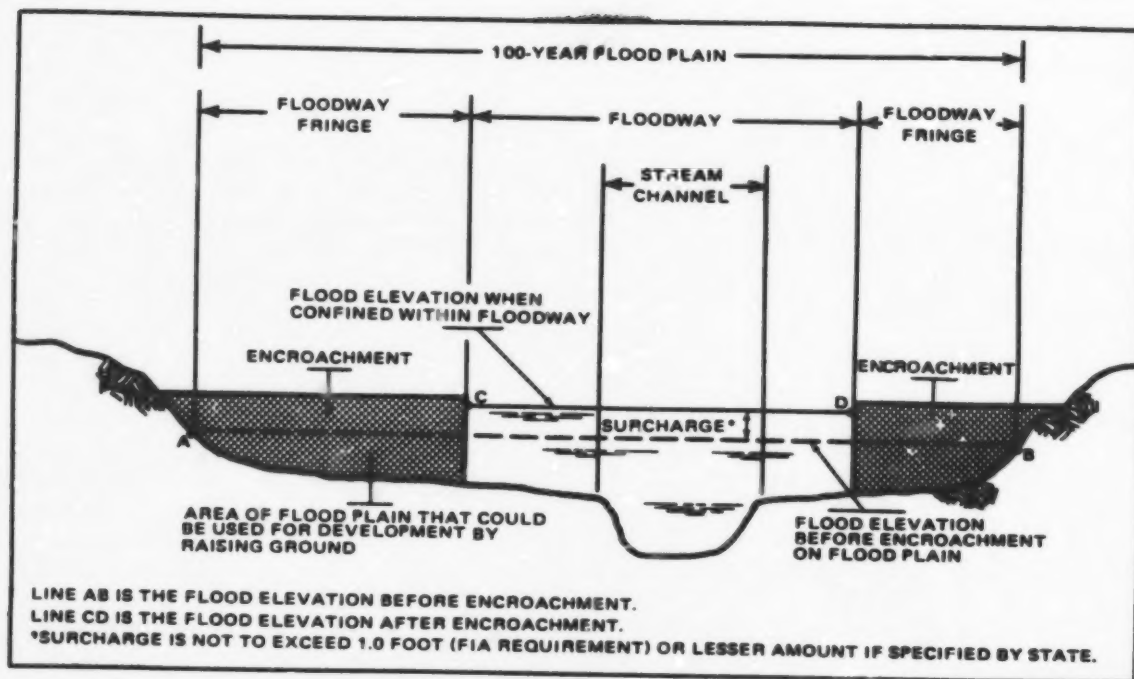


Figure 2. Floodway Schematic

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

A Flood Insurance Study has been conducted for the City of Breckenridge, Minnesota (Reference 7). The results of this study are in agreement with the results of the City of Breckenridge study.

FEMA published a Flood Hazard Boundary Map for Wahpeton (Reference 11) in 1981. Because of the more detailed and current hydrologic analysis, this Flood Insurance Study supersedes the data presented on the Flood Hazard Boundary Map for the Bois de Sioux/Red River of the North within the corporate limits of Wahpeton.

A Flood Insurance Study for Center Township, Richland County, North Dakota is currently being prepared. The results of this study will be in agreement with the results of the Center Township study (Reference 13).

8.0 LOCATION OF DATA

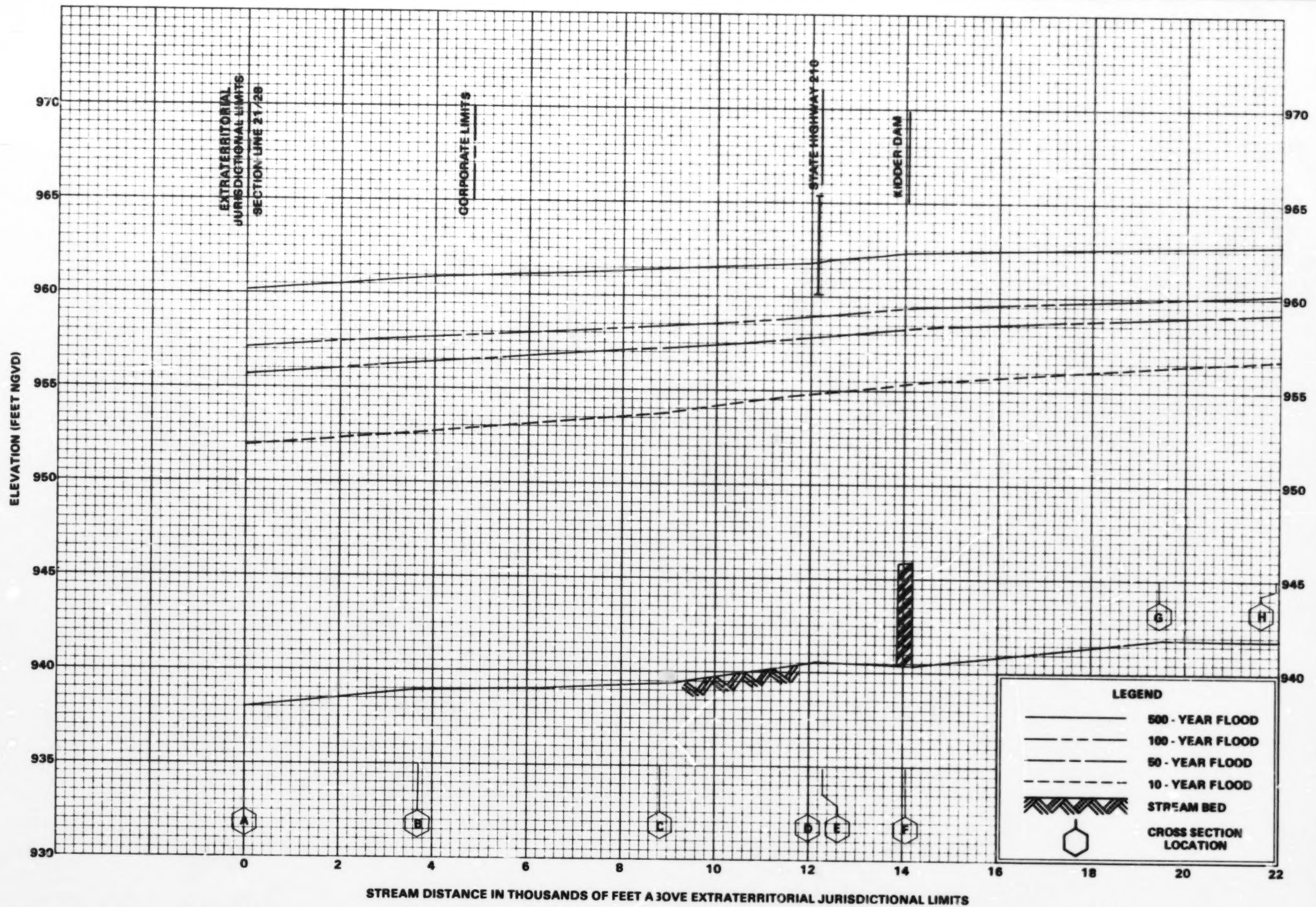
Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Denver Federal Center, Building 710, Box 25267, Denver, Colorado 80225-0267.

9.0 BIBLIOGRAPHY AND REFERENCES

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2. North Dakota State University, Climate of North Dakota, Jensen, 1980.
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7. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Breckenridge, Minnesota, April 1970.
8. U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis California, March 1982.
9. U.S. Department of the Army, Corps of Engineers, St. Paul District, Field Survey Measurements, 1979 and 1984.
10. Mark Hurd Aerial Surveys, Inc., 345 Pennsylvania Avenue South, Minneapolis, Minnesota 55426, September 1985.
11. Federal Emergency Management Agency, Federal Insurance Administration, Flood Hazard Boundary Map, Wahpeton, North Dakota, Scale 1:12,000, June 1981.
12. Minnesota Department of Natural Resources, Division of Waters, Technical Report No. 6, The Regulatory Floodway in Floodplain Management, September 1977.
13. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, Center Township, North Dakota, (unpublished).

EXHIBIT 3 - ELEVATION REFERENCE MARKS
CITY OF WAHPETON, RICHLAND COUNTY, NORTH DAKOTA

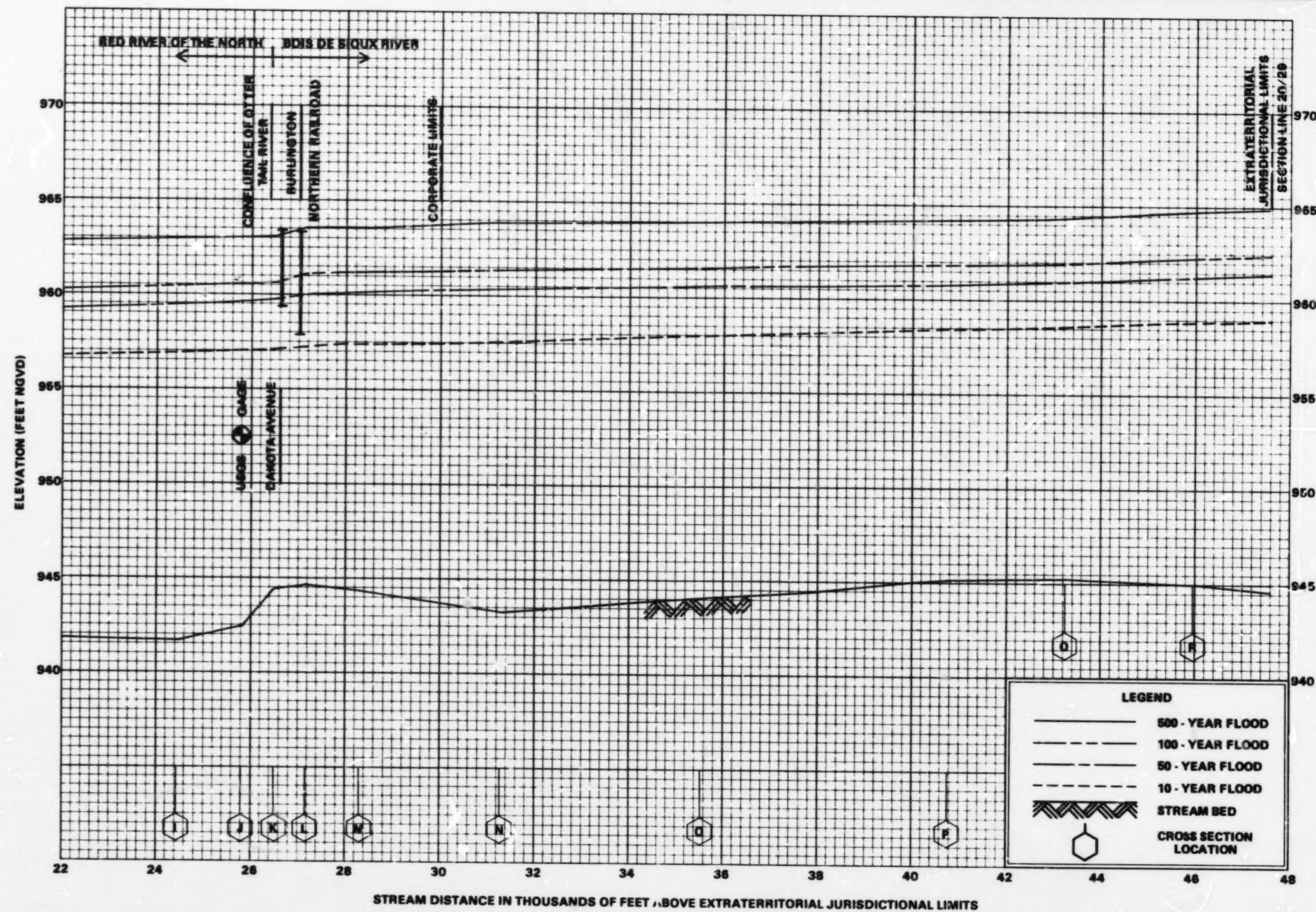
<u>Reference Mark</u>	<u>Elevation (feet NGVD)</u>	<u>Description of Location</u>
RM 1	963.43	Richland County, ND near the center northwest $\frac{1}{4}$ Section 33, T 133 N, R 47 W, 250 feet south of barn on left bank Red River of the North, 36 feet east of the east and south fence corner, 12 feet north of the eastwest fence line in concrete post, a standard CO& brass cap flush with the ground.
RM 2	965.05	Orange chiseled square cut in the Northwest downstream abutment of Highway 210 Bridge over the Red River of the North.
RM 3	966.53	Chiseled square cut in the Northeast downstream Corner Highway 210 Bridge over the Red River of the North.
RM 4	963.34	Top nut, fire hydrant, east end 17th Avenue at cul-de-sac.
RM 5	962.90	USGS Standard Cap "964" riveted on top of 3 $\frac{1}{2}$ " iron pipe at northwest corner of 4th St. and 2nd Avenue North intersection.
RM 6	961.78	Chiseled "X" cut in the northwest downstream abutment of the Burlington Northern Railroad over the Bois de Sioux River.



FLOOD PROFILES
RED RIVER OF THE NORTH

FEDERAL EMERGENCY MANAGEMENT AGENCY
CITY OF WAHPETON, ND
(RICHLAND CO.)

01P



FLOOD PROFILES

RED RIVER OF THE NORTH - BOIS DE SIOUX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WAHPETON, ND
(RICHLAND CO.)

02P

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